PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1953-54

SOUTHERN RHODESIA

PUBLISHED BY

THE EMPIRE COTTON GROWING CORPORATION

12 CHANTREY HOUSE, ECCLESTON STREET,
LONDON, S.W.1.

1955

COMMONWEALTH MYCOLOGICAL INSTITUTE
28 JUL 1955

PROGRESS REPORTS FROM EXPERIMENT STATIONS.

Back numbers are available as follows:—

1923-25 (one volume)	2s	0d
1926-27, 1931-32, 1934-35, 1935-36 ...	2s	6d per vol.
1942-43 and 1945-46 to 1950-51 ...	3s	0d ,, ,,
1951-52 onwards. Individual Reports		9d each
Set of Reports ...	7s	6d

[*Published by courtesy of the Government of Southern Rhodesia.*]

SOUTHERN RHODESIA

COTTON RESEARCH STATION, GATOOMA
PROGRESS REPORT FOR THE SEASON 1953-54

BY

F. E. M. GILLHAM.

Sowing: November 11th to November 23rd, 1953.
Flowering: Mid January to mid February, 1954.
Picking: May 5th to June 25th, 1954.
Legal Uprooting Date: October 1st.

Introduction.

The staff for the year comprised F. E. M. Gillham, Plant Breeder-in-Charge, who shared the plant breeding and agronomy work with P. D. Waister and Mrs. N. Fitt, Mr. Waister being mainly responsible for the pathological aspect. Mr. R. N. Graham of St. Andrews University joined the staff on February 23rd and took over most of the work on insect pests. Mr A. H. McKinstry continued with cotton development work.

Meetings of the Research Advisory Sub-Committee were held on September 24th, January 27th and June 6th.

Forty visitors signed the Visitors' Book. These included Mr. Littlewood, Chairman of the Empire Cotton Growing Corporation, who visited the Station on March 17th, and Mr. Underwood of the Shirley Institute, on June 23rd.

Mr. Waister and Mr. Gillham visited Namulonge in January to gain first-hand knowledge of the work being done there, and to discuss its possible application at Gatooma. Mr. Gillham visited the Barberton Research Station to discuss cotton research in the Eastern Transvaal and future co-operation between Barberton and Gatooma Research Stations. Mr. McKinstry and Mr. Gillham addressed a Farmers' Meeting on the Station on March 26th. Mr. Graham visited Nyasaland in August to discuss methods of insect pest control.

Meteorology.

Rainfall was well distributed from November 6th to March 14th. The total rainfall for the season was 32·04″, which is slightly above the 1943-53 ten year average of 30·02″.

Meteorological data for the season are summarised in Table 1.

TABLE 1.

SUMMARY OF METEOROLOGICAL DATA FOR THE SEASON 1953-54.

Month.	Rainfall.		Daily Hours	Relative Humidity.		Air Temperature.		
	Amt. Ins.	Rainy Days.	Sunshine.	8 a.m.	2 p.m.	Max. °F.	Min. °F.	Avr. °F.
July	0·0	0	9·9	65·7	31·8	72·2	43·8	58·0
August	0·0	0	9·7	58·8	25·5	79·8	51·1	65·5
September	0·35	1	9·6	52·9	26·1	80·5	52·1	66·3
October	0·35	1	9·0	48·0	23·8	89·7	61·7	75·7
November	7·08	10	5·7	66·6	47·4	86·1	64·4	75·3
December	5·86	14	6·1	75·5	58·6	82·7	63·7	73·2
January	8·03	19	6·6	77·9	58·6	82·8	63·7	73·3
February	8·16	15	6·5	79·0	64·0	83·0	63·5	73·3
March	2·03	4	8·7	70·8	47·3	83·0	60·8	71·9
April	0·18	1	8·7	67·7	38·1	83·1	58·0	70·6
May	Trace	0	9·3	59·5	30·3	81·6	53·6	67·6
June	0·0	0	9·5	65·0	29·0	72·8	44·3	58·6
Sums	32·04	65	99·3	787·4	480·5	977·3	680·7	
Means			8·3	65·6	40·0	81·4	56·7	

FARM.

The maize crop was 1,982 bags, an average of 10·2 bags per acre. A severe attack of army worm in January was controlled by applications of DDT and BHC.

The development of cotton plants was good but the crop on unsprayed areas was very poor owing to severe insect damage.

Sixty steers were purchased in March for fattening. Fifty-nine were sold to the Cold Storage Commission at an average price of £37 11s. 6d. This gave an average profit per beast of £8 6s. 4d.

PLANT BREEDING.

The object of the plant breeding programme which has been followed since 1951 is to develop a multi-line variety with a high degree of bacterial blight (*Xanthomonas malvacearum*) resistance, a high degree of jassid resistance and a lint of sufficiently high quality to satisfy the needs of Rhodesian spinners and converters.

With this object in view, selections were taken from the hybrid material (Albar 49 × A5851) × A5851 and (Albar 49 × A618) × A618. This material was backcrossed for the second time on to A5851 and A618 respectively. Apart from this, all work with Albar 49 has been discontinued, the Albar 51 strains 627, 640 and 645 being substituted as the source of bacterial blight resistance. The Albar 51 strains 631 and 637 have not shown the resistance of 627, 640 and 645 under Gatooma conditions, and work with these two strains has also been discontinued.

The crosses (A618 × Albar 51) and (A5851 × Albar 51) were backcrossed for the first time on to A618 and A5851 respectively. Selections are to be made in this material during the coming season and further backcrossing will be carried out.

Selections were made in Albar 51 with a view to developing a strain suitable for Rhodesian conditions. The mean ginning outturn of these selections is high and their lint quality is good.

The early and prolific flowering U4 strains S47/9, S47/11, S47/14, S47/16 and S47/25 were crossed with BP52, Albar 51 and MU8A with a view to improving their lint quality, bacterial blight resistance and jassid resistance respectively. These crosses form part of a long term programme aimed at developing strains which can be used in future hybridisation work.

Single plants were selected in 9L34/MB52/1, A5851 and A618; these will be sown in non-replicated progeny rows during the coming season when selections will be made for the following season's replicated progeny trials.

Replicated Progeny Trial.

The replicated progeny trial was a repetition of the one which failed in the 1952-53 season.

Prior to planting, trenches were dug next to the rows for fertilizer. The high yields in this trial seem to indicate a good response to this treatment.

Despite the fact that this trial was sprayed regularly with DDT and BHC, the staining percentage was high, owing mainly to insect damage. Had insecticides not been applied, the yields would have been negligible and strain differences would not have been obtained.

Yields in this trial ranged from 518 to 1,175 lb. per acre with a mean of 856. The significant difference was 271 at the 5% level and 358 at the 1% level. Ginning outturns were generally low, ranging from 28·22 to 34·28 with a mean of 30·98%.

The strains selected for the small bulk trials to be planted at six centres in 1954-55 are:—

9L34/56	9L34/309	9L34/170
9L34/472	9L34/435	9L34/328
9L34/110	9L34/234	9L34/122

The remaining strains in the trial will be 9L34/MB1 and S38/34, or commercial 9L34.

District Variety Trials.

The 1953-54 district variety trials were more promising than those conducted in 1952-53. In 1952-53 the yield and staining percentage ranges were from 12·2 lb. to 696·1 lb. per acre and from 8·9% to 89·9% respectively, while in 1953-54 these ranges were from 114·6 lb. per acre to 1,234·9 lb. per acre and from 13·3% to 87·1% respectively. There does not appear to be any correlation between staining and yield in either season.

In view of the wide range of yields and staining percentages, no further analysis has been attempted on these trials. It can be stated, however, that in both seasons the better quality linted MU8A × BP52[2] progenies A5851 and A618 have done as well as commercial 9L34 (S38/34).

Xanthomonas malvacearum

Following the methods used in the 1952-53 season the breeding material, mainly derived from Albar 49 and Albar 51 hybrids, was stem-inoculated using Dr. Wickens' method and rogued according to its level of resistance.

Some 15,000 plants were inoculated 65 days after germination, and roguing should have commenced from 60 to 80 days later. However, the material gave a very limited reaction to the inoculum and every plant was re-inoculated at 80 days from germination in the hope that differences in susceptibility would be more marked in the mature plants. This proved to be true, but it appeared that the differences arose more from variation in vegetative vigour than from inherent resistance. Some plants bearing a heavy crop almost invariably showed poorer stem resistance than those with good growth but few bolls. This was particularly noticeable in a bulk of 9L34, the present commercial variety.

In order to preserve at least some prolific lines, a lighter selection pressure for bacterial blight resistance was put on the material.

Boll inoculation this season met with little success, even using quite susceptible strains such as BP52 and A5851. At maturity the most severely infected bolls showed only a slight yellowing at the extreme base of the locs. Natural infection is either very limited or masked by bollworm and stainer attack, as shown by the figures quoted under staining investigations below.

Seed of BAR 4/18 (*G. barbadense,* X1730A (B_2 B_{6m})) was sent from the Sudan by Dr. Knight. This material was leaf sprayed, and stem and boll inoculated. With the exception of one plant, which was obviously off type, it showed complete immunity. Crosses were made between BAR 4/18 and various *G. hirsutum* strains carrying B_2.

The development of bacterial blight resistant strains is considered important, although few reports of serious bacterial blight attack have reached either the Government Pathology Department in Salisbury or the Research Station at Gatooma. Primary attack has only been noted once in Station reports since 1927. In this particular instance the crop recovered to yield 1,000 lb. seed cotton per acre, which is more than three times the Southern Rhodesian average for the last ten years.

The angular leaf spot stage is usually seen to any extent only in the young leaves of February and March, later leaves showing little or no sign of attack.

Staining of Seed Cotton.—There is little information available as to the position of *X. malvacearum* as a cause of staining of seed cotton in Rhodesia. During the past season an attempt was made to differentiate the causes of staining in various areas of the colony, by flower tagging methods.

With the assistance of the staff of four other research stations (Henderson, Salisbury, Gwebi and Karoi) a series of five tagging experiments was carried out. The aim at each centre was to tag 300 white flowers per week over a period of five to six weeks from the commencement of flowering.

In all cases the staining caused by insect pests was far in excess of that caused by bacterial blight. As may be expected, therefore, the application of insecticides brought about a decrease in overall staining accompanied by a slight increase in the percentage caused by bacterial blight.

Results of taggings at Gatooma are given in Table 2.

TABLE 2.

RESULTS OF DATE TAGGING OF FLOWERS AT THE COTTON STATION.

Tagging Date.	*No. of Tags.*	*Fate of Flowers.*							*Undamaged Bolls.*	*Tags Not Recovered*
		Shed Bolls Due to			*Mature Bolls Damaged by*					
		B.W.	*X.M.*	*Others*	*B.W.*	*X.M.*	*Stainers.*	*Others.*		
16:2:54	300	137	5	10	108	6	5	11	3	15
19:2:54	300	152	10	28	83	8	1	3	2	13
25:2:54	300	177	4	16	75	4	1	3	3	17
4:3:54	300	196	17	25	48	9	1	0	2	2
11:3:54	300	220	7	14	34	5	0	2	0	18
18:3:54	300	232	1	13	23	1	0	2	0	28
25:3:54	300	225	5	21	12	0	0	0	0	37
Totals	2100	1339	49	127	383	33	8	21	10	130

The extent of damage due to bollworm attack far surpasses that due to any other cause.

Out of 2,100 flowers labelled during the season 1,722 were either shed or the resulting bolls damaged due to bollworm attack.

The importance of *X. malvacearum* as a cause of boll damage cannot be accurately assessed until some method of bollworm control has been developed.

Programme for 1954-55

The number of centres at which district variety trials will be conducted will be reduced from nineteen to thirteen. At six of these centres, small bulk trials of strains selected from the 1953-54 progeny trials will be conducted.

A main strain trial at the Station is planned comprising commercial 9L34 as control and various strains selected from U4, 9L34 and MU8A × BP52[2] material.

In addition, a number of strains were received during the year from the Sudan and French Equatorial Africa; these will be sown in observation plots with several American varieties which have previously been tried at Gatooma, and with commercial 9L34 as control.

Samples of Funtua Allen, Mai-Inchi Allen and Samaru 26C from Nigeria have been planted and will be submitted to heavy bacterial blight infection.

In the light of this year's experience a more extended time-of-inoculation trial must be laid down. This season's trial showed no significant difference in response between plants inoculated at 50, 60 and 70 days after germination.

Next season's programme will include a trial to determine the influence of the onset of the reproductive phase on the blackarm susceptibility of cotton under Rhodesian conditions.

A comprehensive programme of ten factorial fertilizer trials is planned for the coming season. These will cover the application of N, P, and K at three levels in all combinations, with N in the form of ammonium sulphate, sodium nitrate and nitrolime applied at planting, 35 days after germination and 59 days after germination. K will be in the form of potassium sulphate and potassium chloride.

These trials have been planned from the results obtained in a similar series of trials conducted in the season 1951-52.

For the time being no work is being conducted on cultural methods or crop rotations but it is hoped that work on these two lines of investigation will be started in the 1955-56 season.

Insect Pests.

Difficulties were experienced in obtaining insect records before the latter half of February. From general observations, however, it appears that red bollworm attack was very heavy throughout the season, and only during the first half of May was there any appreciable drop in numbers. Spiny bollworm attack was also serious and the damage done to the growing tips of young plants was considerable. The numbers of spiny bollworm were constant throughout the season and even in July, after the completion of harvesting, they were to be found in considerable numbers. American bollworm attack was at no time serious except in a bulk of commercial 9L34 which was not sprayed.

Stainers were not present to any extent until the middle of May when large numbers of young nymphs were noticed feeding on bollworm damaged bolls which had opened prematurely. Jassids could not be

found in the lands except in the 9L34 bulk referred to above. Aphids were not noticed until the second half of April when material which had been sprayed earlier became heavily infected, although by this time the crop was too far advanced to be affected by the damage.

Insecticides and Spraying

Because of past experience of heavy insect attacks, it was arranged to spray all the breeding material. The only unsprayed material on the Station was a commercial bulk of 9L34 which was not reaped owing to its very poor yield of about 100 lb. per acre.

All liquid insecticides except Parathion were applied with Mysto knapsack sprayers. Leo Colibri sprayers were used for Parathion as they are less likely to leak. The duster used was an Eurova bellows-type, which did not prove satisfactory, especially with the low rate of application.

Despite the application of insecticides, yields were very variable and staining percentages generally high.

TABLE 3.

SUMMARISED RESULTS FROM AN INSECTICIDE TRIAL, 1953-54.

Randomised block with four replications each of fifteen treatments plus control. Plot size 90 feet × 19 feet, separated by six rows of sorghum. Replications separated by 10 yard paths.

NOTE: Spraying commenced on 13/1/54: Main flowering period commenced on about the 23rd January.

Treatment No.	TREATMENTS. Number of Days from Start of Treatment. 0	7	17	24	38	39	45	49	52	59	59	69	Total S/C Yield Lb./Acre.	% Stained.	Profit Increase over Control.	Cost of Insecticide per Acre.
12	Pa	Pa	Pa	P		PPa		PPa			PPa	PPa	616	29·7	181/-	176/-
4	P	P	P	P		PL		PL			PL	PL	523	34·2	59/-	233/-
2	WP	WP	WP	WP		WP		WP			WP	WP	481	34·0	62/-	192/-
3	PL	PL	PL	PL		PL		PL			PL	PL	464	37·7	−82/-	317/-
11	Pa	Pa	Pa	P		PL		PL			PL	PL	456	39·6	9/-	215/-
5				P		PL		PL			PL	PL	452	38·7	51/-	174/-
1	D	D	D	D		D		D			D	D	444	36·9	72/-	151/-
8				P		PL		PL			PL		389	38·9	49/-	135/-
10	T	T	T	T		T		T			T	T	288	34·8	19/-	98/-
9				P		PL		PL					239	43·3	− 1/-	95/-
6						PL		PL			PL	PL	234	46·9	−82/-	168/-
15	D*	D*	D*	D*	D*		D*		D*	D*			233	48·6	13/-	61/-
7								PL			PL	PL	216	44·5	−50/-	119/-
13		PL*	PL*	PL*	PL*		PL*		PL*	PL*			186	57·4	−69/-	107/-
14	B*	B*	B	B	B		B		B	B			160	50·5	−297/-	377/-
16	CONTROL												110	54·2		

Key to Treatments:

P=Psylortox DDT; Pa=Parathion; T=Toxaphene; L=Lindicide;

B=DDT/BHC Bait; WP=DDT/BHC Wettable Powder; D=DDT/BHC Dust.

*Low rate of application—0·6 lb. DDT + 0·18 lb. gamma BHC in dust or spray form per acre.

Other treatments at the rate of 1½ lb. active DDT + ½ lb. BHC per acre.

Parathion and Toxaphene were applied at recommended rates.

Profit increase over control = cash value of cotton from treatment less the cost of insecticide and cash value of cotton from control.

For significance at P = 0·05 difference in yield required = 227 lb. per acre.

The main results of the trial were: —

1. Eight of the fifteen treatments yielded significantly better than the control plots. Of these seven showed a profit increase. The loss on the eighth treatment was due to the high cost of insecticide.
2. Parathion-Psylortox treatment returned the highest yield but the Parathion component makes it inadvisable to recommend such a treatment for use by unskilled operators.
3. A comparison of DDT/BHC dust, emulsion and wettable powder showed no significant difference in yield but on an economic basis dust and wettable powder are far superior to emulsion, and dust is easier to apply.
4. A comparison of the time-of-application treatments, numbers 5-9, showed that the earlier the treatment is started the better, and that time of application is more important than the number of applications.

Plans for next season include an expansion in the work on time, rate and number of applications of DDT/BHC dust and emulsion. A trial will also be carried out of any new insecticides against the present range in use.

TABLE 4.

RESULT OF TAGGING EXPERIMENT CARRIED OUT IN INSECTICIDE TRIAL.

NOTE: All percentages are expressed as % of total numbers of tags recovered.

Treatment No.	*Total Yield S.C. Lb./Ac.*	*% Bolls Shed due to*		*% Bolls Reaching Maturity.*	*% Bolls Undamaged.*
		B.W.	*Other Causes.*		
4	940	53·5	17·2	29·5	5·8
5	867	49·4	24·5	26·1	5·3
11	688	51·8	20·6	27·8	3·9
12	634	53·0	23·7	23·3	1·9
2	626	59·4	21·9	18·7	1·9
1	553	60·7	16·6	22·8	2·1
10	414	63·9	20·1	14·9	0·9
9	270	68·5	20·5	10·9	1·0
6	239	63·5	18·9	17·6	0·7
14	219	70·4	17·1	11·5	0·3
7	212	62·9	21·9	15·1	0·8
15	202	66·3	21·3	12·3	
16	147	78·1	17·2	4·6	
13	126	77·4	12·9	9·7	
16	112	78·1	17·2	4·1	
3	110	74·3	15·5	10·2	
16	101	74·2	21·7	4·2	

Tagging Experiment

An experiment was conducted in the insecticide trial to see whether, by tagging white flowers, it was possible to trace the effect of the treatments. For the experiment one replication of the trial and the three control plots were used. In one discard row of each plot a

maximum of 50 white flowers were tagged each week, starting on 20th February for seven weeks. It was, unfortunately, not possible to start this any earlier; to get good results tagging should have started at the beginning of flowering, during the last week in January.

During the reaping of the insecticide trial errors were made in cutting out discard rows which resulted in the abandoning of the plot of treatment number 8 and one of the control plots. The results show an overall heavy bollworm attack with 77·6% of the flowers tagged being attacked by bollworm and out of a total of 4,774 flowers tagged only 76 bolls were reaped undamaged. The percentage of sheds due to other causes was high but this was mainly due to labels being recovered without bolls and to boll sheds at an early stage, in which there was no apparent cause of damage. The results indicate that the insecticide has controlled bollworm to a certain extent.

SUMMARY.

For the first time a general insecticide programme was planned. Despite this, yields were very variable and staining percentages were high. Sprays appeared to control American bollworm, jassid, aphis and stainers but, at best, red and spiny bollworms were only partially controlled.

In an insecticide trial a Parathion/Psylortox treatment gave the highest yield and profit but the Parathion component makes it inadvisable to recommend this treatment for general use. A 10% DDT + 3% gamma BHC dust appears to be the best treatment for general use. The importance of early applications of insecticide is stressed.

By comparison with the staining caused by insect pests, that due to bacterial blight was of little account.

The importance of time of stem inoculation for assessment of bacterial blight resistance in relation to fruiting development is stressed. This season the tendency has been for plants with a good crop to show less resistance to bacterial blight than plants with a more vegetative habit.

Progress is being made in the earlier generations of backcrosses in the selection of strains with good bacterial blight resistance in combination with desirable agronomic and lint characters. For this work Albar 49, and more recently, Albar 51 have been crossed with A5851 and A618.

At the same time commercial 9L34 is being sieved for the main useful characters of which the strain is capable.

A more effective control of insect pests, especially red and spiny bollworm, is essential for normal progress of the breeding and agronomy work on cotton.

Received January 1955.

T. BUNCLE AND CO. LTD., ARBROATH.